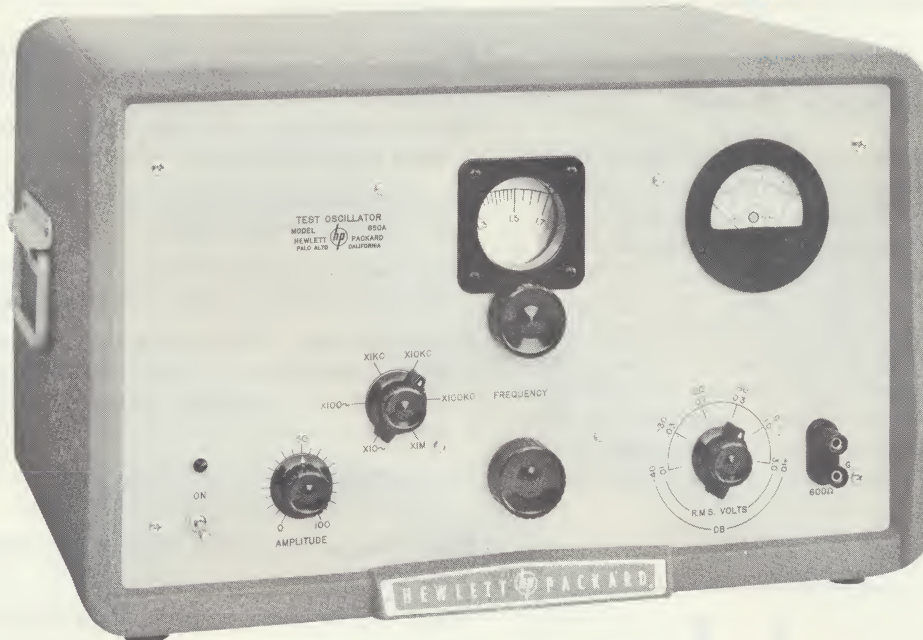




Advantages:

- No zero setting
- Wide frequency range
- No adjustments during operation
- Output voltage attenuator
- Self-contained vacuum tube voltmeter
- High stability
- Ease of operation
- Accurate, reliable metered output

Uses:

- Testing television amplifiers
- Wide-band systems
- Filter transmission characteristics
- Tuned circuit response
- Determining receiver alignment
- Telephone carrier measurements
- Bridge measurements

Description

The hp Model 650A Oscillator brings audio frequency speed, accuracy, and ease of operation to higher frequency fields. Its wide frequency range, 10 cps to 10 MC, makes Model 650A ideal for a wide variety of measurements in audio, ultrasonic, video, and rf bands. It is a wide-band highly stable precision instrument which provides output flat within 1 db throughout its frequency range. Its voltage range is 0.00003 volt to 3 volts. Output impedance is 600 ohms, and, for measurements where low source impedance is desired, a 6-ohm impedance is provided by means of an output voltage divider.

Decade Ranges, Output Voltmeter

Like other hp resistance-capacitance oscillators, Model 650A is fast and easy to operate. Six decade frequency ranges provide an effective scale length of 94 inches. The tuning dial is controlled directly, or with a 6 to 1 vernier for hairline adjustment. Frequencies are read through a non-parallax illuminated window.

The output voltage is monitored by a vacuum tube voltmeter which measures the voltage at the input to the attenuator system. The VTVM is calibrated in volts and decibels and reads actual output voltage when the attenuators are set for zero attenuation. For other attenuator settings, true output voltage is obtained by subtracting the attenuator reading

hp 650A EEM 2900

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ELECTRONIC MEASURING EQUIPMENT

HEWLETT-PACKARD COMPANY
1501 PAGE MILL ROAD
PALO ALTO, CALIFORNIA, U.S.A.
CABLE: "HEWPACK" DAVENPORT 6-7000



RUE DU VIEUX BILLARD NO. 1
GENEVA, SWITZERLAND
CABLE: "HEWPACKSA" TEL. NO. (022) 26.43.36

from the output voltmeter reading. The output attenuator is adjustable in 10 db steps and maximum attenuation is 50 db. The voltage applied to the vacuum tube voltmeter and thus to the output attenuator is set by means of an amplitude control. The attenuated output voltage is correct only when the output terminals are loaded with 600 ohms, resistive.

Output Voltage Divider

Where small test signals or a low-source impedance is required, a voltage divider is provided (shown connected to instrument in Figure 1). Two sets of voltages are obtainable from this divider. One voltage is one one-hundredth of the normal output voltage from the 650A and is delivered from a source impedance of only 6 ohms. True voltage is obtained at these terminals when they are connected to a load resistance which is large compared to 6 ohms. The second voltage is the actual output voltage of the Model 650A and is delivered from a source impedance of 300 ohms. Proper voltage is obtained at these terminals when working into a load resistance which is large compared to 300 ohms.

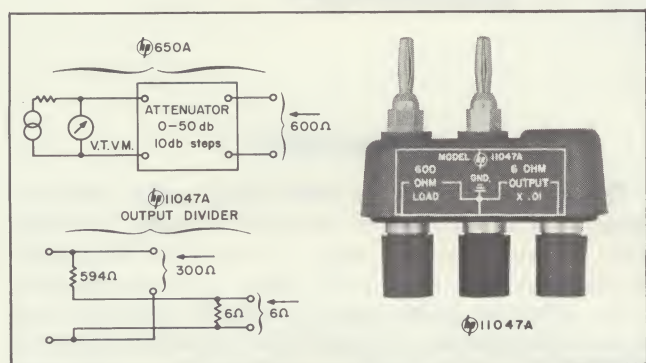


Figure 1

Circuits of the Φ Model 650A have been carefully proportioned and low-temperature coefficient components have been employed to assure highest frequency stability. Output voltage will remain constant over long periods of time, despite wide variations in temperature. Distortion over the low-frequency bands is kept at a minimum to increase the usefulness of the instrument for audio measurements.

Uses

Employing essentially the same resistance-capacitance circuits as Φ audio oscillators, this wide-band stable Φ Model 650A is ideally suited for laboratory and production jobs where fast, accurate wide-band measurements are required. It is specifically designed for the testing of television amplifiers, audio amplifiers, filter networks, tuned circuits, and telephonic and telegraphic carrier equipment. It serves admirably as a power supply for af and rf bridge measurements.

Specifications

Frequency Range: 10 cps to 10 MC. Six decade bands.

Calibration Accuracy: $\pm 2\%$, 10 cps to 100 KC, $\pm 3\%$, 100 KC to 10 MC including warmup, and $\pm 10\%$ line voltage variation.

Output: 15 milliwatts or 3 volts rms into 600-ohm resistive load. Open circuit voltage is at least 6 volts rms.

Source Impedance: 600 ohms; 300 ohms or 6 ohms when using 65A-16D Output Divider Cable.

Frequency Response: Flat within ± 1 db, 10 cps to 10 MC into 600 ohm resistive load.

Distortion: Less than 1% from 20 cps to 100 KC. Less than 2% from 100 KC to 1 MC, approximately 5% at 10 MC.

Output Monitor: Vacuum tube voltmeter monitors level at input to attenuator, in volts or db at 600 ohm level. Zero db=1 mw in 600 ohms. Accuracy $\pm 5\%$ of full scale reading.

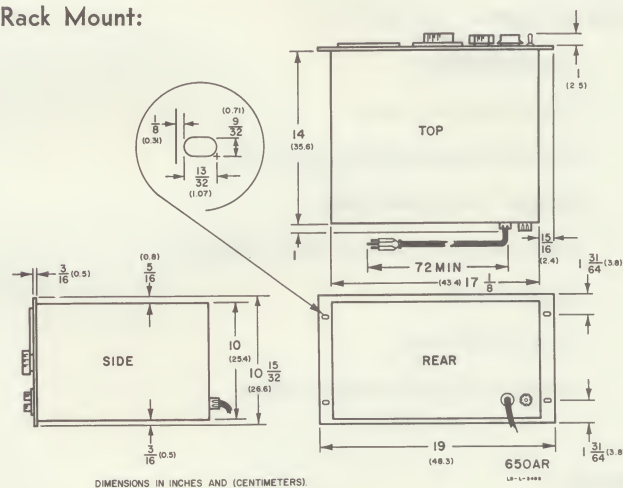
Output Attenuator: 0 to 50 db in 10-db steps. Accuracy ± 1 db, into resistive load of 600 ohms.

Hum Voltage: Less than 0.5% of output voltage with meter at full scale.

Power: 115 or 230 v $\pm 10\%$, 50 to 1,000 cps, 165 watts.

Dimensions: Cabinet Mount: 20 $\frac{3}{4}$ " wide, 12 $\frac{3}{4}$ " high, 15" deep. Rack Mount:

Rack Mount:



Weight: Net 46 lbs. (20.7 kg.). Shipping 55 lbs. (24.7 kg.). (cabinet mount). Net 37 lbs. (16.65kg). Shipping 52 lbs. (23.4kg). (Rack Mount).

► **Accessories Furnished:** One 11047A Output Divider.

► **Accessories Available:** 11000A Cable Assembly, \$4.50; 11001A Cable Assembly, \$5.50.

11047A Output Divider (one each furnished with instrument) \$25.00.

Price: Φ 650A, \$550.00 (cabinet); Φ 650AR, \$535.00 (rack mount).

Prices f.o.b. factory

Data subject to change without notice

► Indicates change from prior specifications

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Features

- Wide frequency range 10 cps-10 Mc
- Excellent frequency stability
- Accurate 90 db output attenuator
- Low distortion
- Completely solid-state
- Flat frequency response
- Accurate easy-to-read output monitor
- Large, accurate, easy-to-read frequency dial
- Excellent frequency and amplitude setability

Uses

- Response testing at audio and communication frequencies; narrow or wide-band devices
- Low distortion source in the presence of shock, vibration or hf radiation
- Measure filter transmission characteristics and tuned circuit responses
- Telephone carrier measurements
- Bridge measurements
- Testing video amplifiers
- Voltmeter calibration
- Amplifier loop gain plots
- Align receivers
- Measure gain or loss of networks
- Laboratory or field supply of low distortion signals

Description

The solid-state Φ Model 651A Test Oscillator provides accurate stable test signals for laboratory or production measurements. This instrument covers a wide frequency range from 10 cps to 10 Mc, continuously variable across six bands.

Two output impedances are available from the front panel, providing 200 mw into 50 ohms or 16 mw into 600 ohms. This capacitance-tuned oscillator delivers a flat output throughout the entire frequency range. This is obtained by using precision components and peak detector AGC circuitry.

Hum and noise are reduced below 0.05% of the output by use of low impedance, solid-state circuitry and shielded power supply transformer. The solid-state design, which contributes to superior stability, reduces the effect of shock or vibration that is often present in test areas.

Once warmed up, and in a normal laboratory environment, where ambient temperature does not change more than 3 or 4 degrees C over a 24 hour period, the frequency stability at 5 Mc is typically ± 10 PPM.

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GENEVA, SWITZERLAND
CABLE: "HEWPACKSA" TEL. (022) 42.81.50

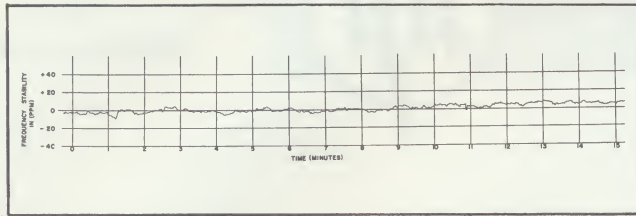


Figure 1. Typical Frequency Stability Characteristics at 5 Mc for 15 Minutes.

An indication of the overall frequency stability under the above conditions is shown in Figure 1 which illustrates the behavior over a 15 minute period. The typical frequency stability for a 24 hour period at 5 Mc is $\pm 0.02\%$. The frequency stability at lower frequencies is typically better than those shown in the top frequency band.

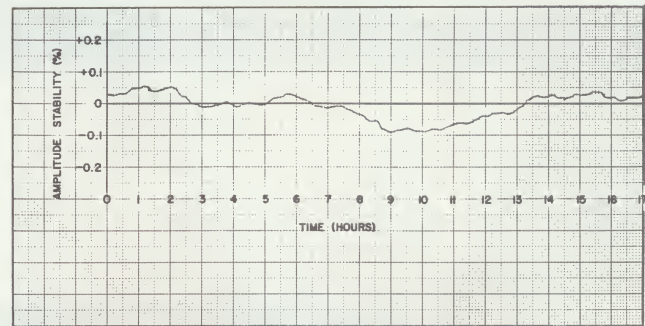


Figure 3. Typical Amplitude Stability at Mid-Band Frequencies for 17 Hours.

USES

Employing essentially the same resistance capacitance circuits as other Φ audio oscillators, this wide-band solid-state Φ Model 651A is ideally suited for laboratory and production jobs where fast, accurate wide-band measurements are

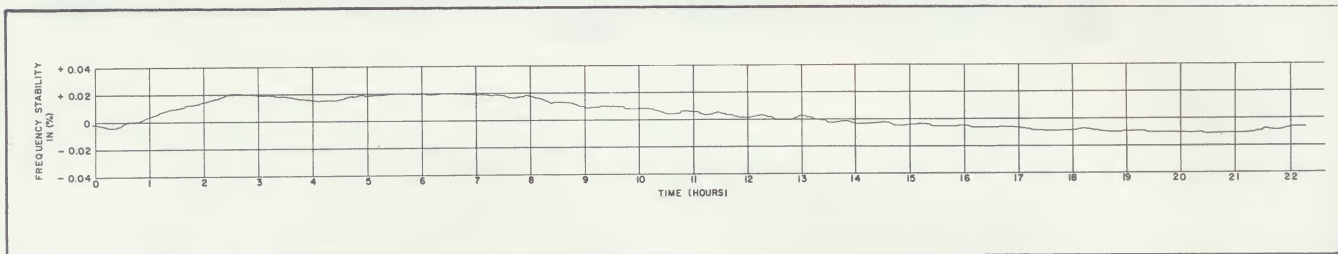


Figure 2. Typical Frequency Stability Characteristics at 5 Mc for 22 Hours.

Typical amplitude stability over a 17 hour period is $\pm 0.1\%$ as shown in Figure 3.

OUTPUT MONITOR AND ATTENUATOR

A high impedance voltmeter measures the output of the power amplifier. The meter is calibrated to read volts or dbm into a 50 ohm load. For any attenuator setting, true output* is obtained by subtracting the attenuator reading from the output voltmeter reading. The output attenuator has a 90 db range, adjustable in 10 db steps with a 20 db vernier. Two outputs—50 and 600 ohm—are available on the front panel. The standard 651A output monitor is calibrated to read dbm for 50 ohms (0 dbm = 1 mw into 50 Ω). The Model 651A (option 01) is calibrated to read dbm for 600 ohms (0 dbm = 1 mw into 600 Ω). The Model 651A (Option 02) has a 75 ohm and 600 ohm output. The output monitor is calibrated to read dbm for 75 ohms (0 dbm = 1 mw into 75 Ω). Output impedances not listed are available to meet your particular requirements. Discuss your application with your Φ sales engineer.

* Model 651A (option 01) calibrated to read dbm into 600 ohms.

required. It is specifically designed for the testing of television amplifiers, audio amplifiers, filter networks, tuned circuits and telephone and telegraphic carrier equipment. It serves as a power supply for af or rf bridge measurements. It is useful when making loop gain plots on amplifiers and functions well when calibrating voltmeters because of its accurate attenuator and output monitor.

ACCESSORIES

BALANCED OUTPUT. The Hewlett-Packard accessories Model 11004A and 11005A Line Matching Transformer and Bridging Transformer (optional equipment) are designed to connect an oscillator to a balanced system. The 11004A Transformer has a frequency response between 5 Kc and 600 Kc providing fully balanced outputs for 135 or 600 ohms. The 11005A Transformer has a frequency response between 20 cps to 45 Kc providing a fully balanced output into 600 ohms. Accessory 11001A Cable is a male BNC to dual banana plug which provides connection to accessories 11004A and 11005A to the Φ Model 651A.

An accessory 11048A 50 ohm feed-thru termination is available (optional equipment) which is specifically designed to terminate the 50 ohm output of an oscillator.

SPECIFICATIONS

Frequency Range:

10 cps to 10 Mc, 6 bands, dial calibration: 1 to 10.

Frequency Response:

Flat within $\pm 2\%$ 100 cps to 4 Mc, $\pm 3\%$ 10 cps to 100 cps $\pm 4\%$ 4 Mc to 10 Mc.

Dial Accuracy and Resolution:

$\pm 2\%$, 100 cps-1 Mc, $\pm 3\%$ 10 to 100 cps, $\pm 3\%$ 1-10 Mc. Including warm-up drift and $\pm 10\%$ line variations.

Frequency Stability (short term):**

Typically 10 ppm.

Distortion:

Less than 1% 10 cps to 5 Mc, approximately 2% at 10 Mc.

Output:

200 mw (3.16 v into 50 ohms); 16 mw (3.16 v into 600 ohms) 6.32 v open circuit.

Amplitude Control:

20 db range (nominal).

Hum and Noise:

Less than .05% of output.

Output Monitor:

Voltmeter monitors level at input of attenuator in volts or db. Top scale calibrated in volts. Bottom scale calibrated in db. Accuracy $\pm 2\%$ of full scale.

Output Monitor Flatness:

$\pm 1\%$ at full scale, 20 cps-4 Mc. $\pm 2\%$ at full scale 10 cps-20 cps and 4-10 Mc.

Attenuator:

Range 90 db in 10 db steps.

Accuracy ± 0.1 db.

$Z_0 = 50$ ohms and 600 ohms.

$Z_0 = 75$ ohms and 600 ohms.*

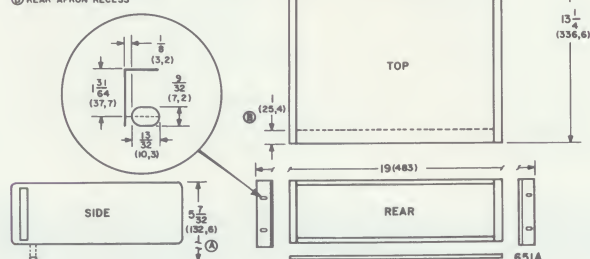
Temperature Range:

0°C to + 50° C.

Dimensions:

5-7/32" (132.6 mm) high, 16 3/4" (425 mm) wide, 13 1/4" (336.6 mm) deep.

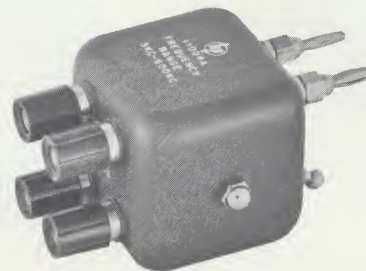
NOTE
DIMENSIONS IN INCHES AND (MILLIMETERS)
(A) EIA RACK HEIGHT (INCLUDING FILLER STRIP)
FOR CABINET HEIGHT (INCLUDING FEET) ADD
3/8" (9.5) TO EIA RACK HEIGHT
(B) REAR APRON RECESS



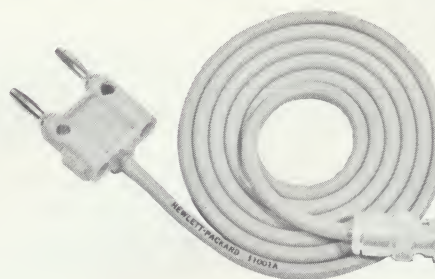
ACCESSORIES AVAILABLE (Not furnished)



11005A Line Matching Transformer (\$80.00)



11004A Line Matching Transformer (\$60.00)



11001A Cable, male BNC to dual banana plug \$5.50



11048A 50-ohm Feed-thru Termination (\$10.00)

Weight:

Net: 17 lbs. (7.65 kg) Shipping: 22 lbs. (9.90 kg)

Power:

115v/230v $\pm 10\%$, 20 watts, 50 to 1000 cps

Price:

Ⓟ 651A, \$590.00.

Option 01: Ⓟ 651A Output Monitor top scale calibrated in dbm/600Ω. Bottom scale calibrated in volts. \$615.00.

Option 02: Ⓟ 651A Output: 75 ohm and 600 ohm. Output monitor top scale calibrated in dbm/75Ω. Bottom scale calibrated in volts. \$615.00.

* Note:

Option 02: Other output impedances above 50 ohms are available on special order.

** One minute

Prices f.o.b. factory
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► Indicates change from prior specifications

8/15/64